R-10-A

DC
RECORDER MANUAL

Models 288, 291, 2146,
2194 & 300 Series

#16906
2nd Edition, 8-70

rustrak
THE MINIATURE RECORDER PEOPLE
RUSTRAK Instrument Div. • GULTON Industries Inc.
Municipal Airport, Manchester, New Hampshire 03103.
(603)623-3591

Receiving

Each polyfoam case contains a recorder, a manual and one roll of chart paper, "200" Series recorders also come with a hardware kit. Missing items should be reported to your distributor.

In case of damage in shipping, notify your carrier immediately. Don't destroy packing material or containers (whether or not shipping box is intact) until your agent has examined them.

Under U.S. shipping regulations, damage claims must be collected by the consignee. Don't return merchandise damaged in shipping until your claim is examined and recorded.

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Rustrak warrants each instrument of its manufacture to be free from defects in material and workmanship under normal usage and service for a period of one year after its initial purchase from the factory or from any authorized Rustrak representative or distributor.

Our obligation under this warranty is limited to repairing or replacing any instrument or component which, upon examination by factory personnel, is found not to conform to the foregoing warranty, providing said instrument is returned to the factory, transportation prepaid. We shall not otherwise be liable for any damages, consequential or otherwise.

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RUSTRAK MINIATURE CHART RECORDERS

WARRANTY REGISTRATION

Model No. _____ **Serial No.** _____

Date purchased _____

NAME _____

COMPANY _____

ADDRESS _____

CITY _____

STATE _____ ZIP CODE _____

Where did you first learn about Rustrak? _____

Was instrument in good order when received? _____

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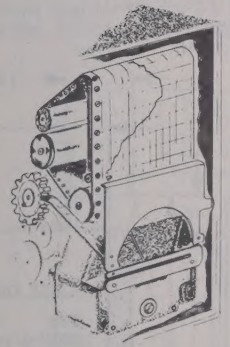
Description



The Rustrak DC* recorder prints through the impinging action of its stylus driven by the chopper bar against pressure-sensitive chart paper. Its presentation is a series of dots appearing as a continuous line.

Recording on the chord of the stylus arc by the edge of the chopper bar is possible with a stylus able to write along its length rather than its point. This results in chart paper printed with straight lines and rectilinear recordings.

Writing speed varies with motor speed. Chart speed and trace density depend on the ratio of the interchangeable gear box which couples the paper drive to the motor.

*DC Recorders are intended to record DC parameters such as voltage or current. The chart drive motor may operate from AC lines or be battery-operated without changing the DC designation.

Summary

Description..... 1
Installation..... 2
Wiring..... 3
Loading Instructions..... 4 & 5
Operating Instructions..... 6
Calibration..... 6
Model 2194 Special Instructions..... 7
Basic ranges of DC recorders..... 8
Chart paper..... 8
Changing Gear Trains (Boxes)..... 8
Cleaning Your Recorder..... 9
Formulas..... 9
Gear Train ratios..... 9
Chart speed table..... 9
Writing speed table..... 9
Trace Density table..... 9
F204 Controller 10
Features & Accessories..... 11
Troubleshooting & Repair..... 12
Exploded View..... Back Cover
"200" Series Template..... Back Cover

Installation

MODELS 288, 291, 2146 & 2194:

These recorders can be panel-mounted or used as table-top portable instruments. Hardware is furnished for both purposes.

Portable:

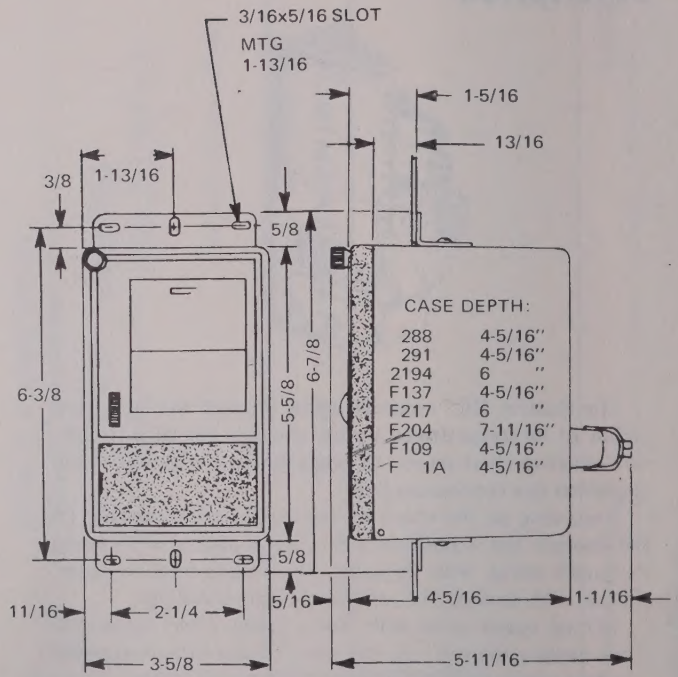
Install four (4) rubber feet in tapped holes at bottom of case using four (4) 4-40 x 1/4" screws provided. Snap white plastic cardholder into holes at top of case.

Panel-Mounting:

Follow instructions on drawing included with hardware kit. Mount both brackets to recorder and make panel cutout to size required or use Model 2176 precut panels. See recorder outline. For custom mounting, see template on back cover. If mounting with Model 2196 escutcheon, do not drill holes in panel and follow special instructions furnished with bezel.

300 SERIES MODELS:

Normally the 300 series recorder is shipped with rubber feet and handle mounted at the factory. It is ready to use as received. However, a modification kit is available for panel-mounting without drilling holes in the case.

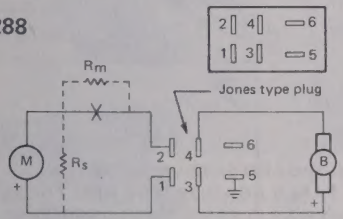


Wiring

Plug connections and terminals are identified on a label inside your recorder. Refer to this data for correct wiring.

SCHEMATICS

Model 288

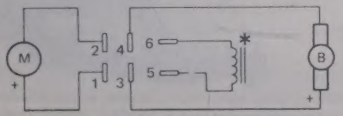


Terminal Connections

PIN #	MODEL 288	MODEL 291	MODEL 2146
1	Galvo +	Galvo 1 +	Galvo +
2	Galvo –	Galvo 1 –	Galvo –
3	Motor (DC+)	Motor (DC+)	Motor (DC+)
4	Motor (1)	Motor (1)	Motor (1)
5	Ground (2) (3)	Galvo 2 +	Actuator
6	(2)	Galvo 2 –	Actuator

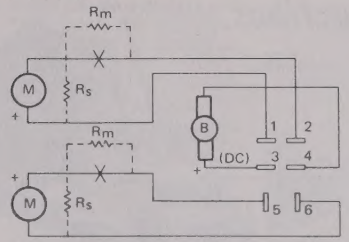
(1) DC Motors are polarized. Positive terminal is *always* pin 3.
(2) Pins 5 & 6 are additional ranges in multi range recorders.
(3) If all pins are used, ground to chassis plug screw.

Model 2146



* Actuator Solenoid, 24 VDC @ 70 MA Standard.

Model 291



$R_s = 100/n-1$ where
R_s = shunt resistor
n = factor

$R_m = (1000\ V_{fs}) \cdot 100$ where
V_{fs} = Volts full scale
100 = Internal R of meter

300 SERIES:

Since a "300 Series" recorder is a tandem unit enclosing two basic "200 Series" instruments, the inner wiring parallels the preceding schematics. Terminals are barrier strips with connections as follows:

TERM. #	8	7	6	5	4	3	2	1
Model 388	NOT USED				– + Galvo 2		– + Galvo 1	
Model 391	– + Galvo 4		– + Galvo 3		– + Galvo 2		– + Galvo 1	
Model 3146	Event Actvator 2		– + Galvo 2		Event Actvator 1		– + Galvo 1	
Other Models	See right Scale		Right center Scale Factor		Left Center Scale Factor		See left Scale	

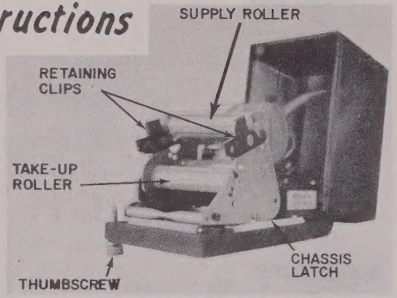
AC line cords terminate in three-prong plugs for 117 VAC. Use grounded outlet. Do not defeat purpose of grounding plug.

DC line cords terminate in a red (+) wire, a black (-) wire and a green lead connected to case ground. Ground this wire when using recorder.

Loading Instructions

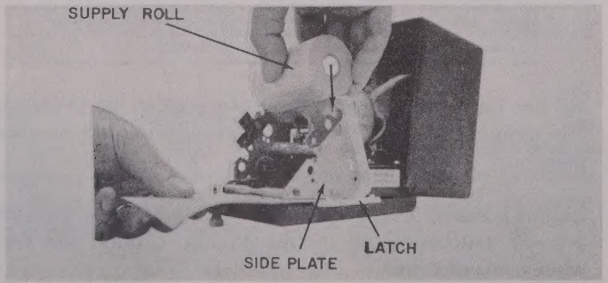
REROLL MODE

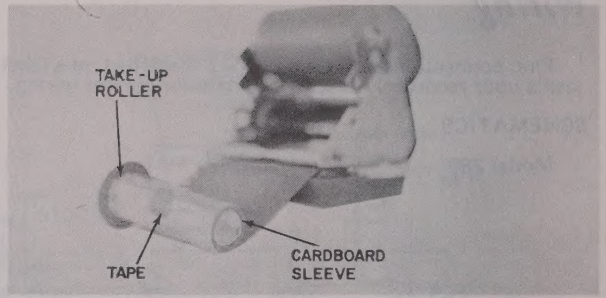
(USE FRESH ROLL OF CHART PAPER AT EACH LOADING)



1. OPEN RECORDER. UNLATCH RETAINING CLIPS. OPEN CHASSIS LATCH. REMOVE SUPPLY AND TAKE-UP ROLLERS.

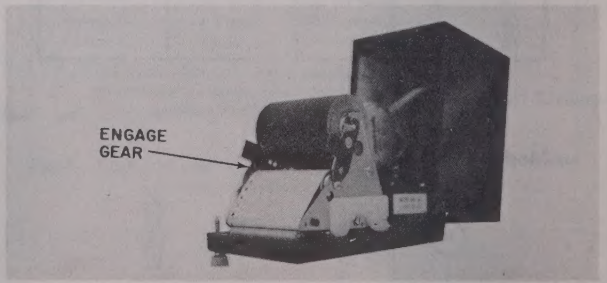
2. SLIDE SUPPLY ROLLER INTO FULL ROLL OF CHART PAPER, ROLLER SHOULDER NEAREST PAPER PERFORATIONS. UNROLL ABOUT A FOOT AND SLIDE PAPER (BACK SIDE UP) BETWEEN SIDE PLATE AND LATCH. ENGAGE PAPER PERFORATIONS IN





3. SLIDE CARDBOARD SLEEVE ONTO TAKE-UP ROLLER. BUTT PAPER AGAINST DISC AND TAPE END OF CHART PAPER TO SLEEVE. TURN ONE REVOLUTION FOR PROPER PAPER ALIGNMENT.

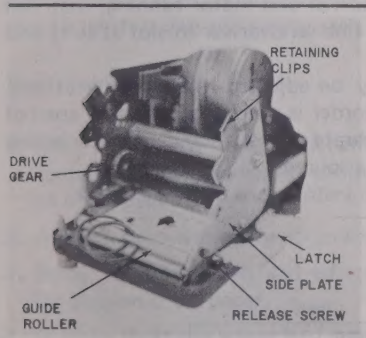
4. ROLL PAPER TIGHTLY AND STRAIGHT ON TAKE-UP ROLLER AND DROP INTO DEEPER NOTCH. ENGAGING GEAR. CLOSE RETAINING CLIPS. SNAP UP CHASSIS LATCH. CLOSE RECORDER. ADVANCE PAPER BY DEPRESSING AND TURNING CHART ADVANCE WHEEL ON FRONT PANEL.



TEAR–OFF MODE

(USE PARTIAL OR FULL ROLLS OF CHART PAPER)

1. SNAP OUT NAMEPLATE USING SCREWDRIVER. REMOVE 2 BELTS. REPLACE NAMEPLATE.



2. OPEN RECORDER. UNLATCH RETAINING CLIPS. OPEN CHASSIS LATCH. REMOVE SUPPLY AND TAKE-UP ROLLERS. UNSCREW RELEASE SCREW 2 OR 3 TURNS. SPRING SIDE PLATE. REMOVE GUIDE ROLLER. SLIP ROLLER THROUGH 2 BELTS. RESEAT ROLLER TIGHTEN RELEASE SCREW.

CONVERSION INFORMATION

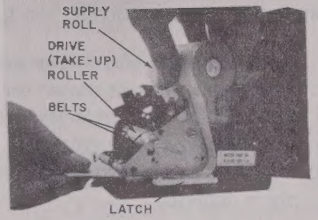
REROLL TO TEAR–OFF (uses drive belts)

Remove cardboard sleeve from take-up roller. Proceed with tear-off loading instructions.

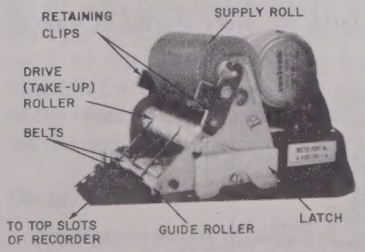
TEAR–OFF TO REROLL (Uses cardboard sleeve)

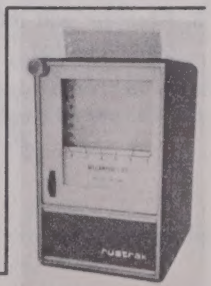
Store drive belts under front nameplate. Replace guide roller and finger tighten knurled release screw. Continue with reroll loading instructions.

3. PASS TAKE-UP ROLLER THROUGH BELTS. SEAT ROLLER TO ENGAGE DRIVE GEAR. PULL BELTS INTO CHAMFERED CENTER GROOVE OF GUIDE ROLLER AND ALIGN INTO V-SLOTS ON TAKE-UP ROLLER. INSERT SUPPLY ROLLER INTO SPOOL OF CHART PAPER (MAY BE PARTIAL ROLL) SO ROLLER SHOULDER IS NEAREST PERFORATIONS. UNROLL CHART PAPER AND SLIDE (BACK SIDE UP) BETWEEN SIDE PLATE AND LATCH. ENGAGE PAPER PERFORATIONS INTO DRUM SPROCKETS AND DROP ROLL INTO SEATING NOTCHES.



4. CLOSE RETAINING CLIPS. SNAP UP CHASSIS LATCH. PULL DRIVE BELTS INTO V SLOTS ON GUIDE ROLLER. CLOSE RECORDER.





5. ADVANCE PAPER AND SET TIME BY DEPRESSING AND TURNING CHART ADVANCE WHEEL. TEAR-OFF PAPER AS NEEDED.

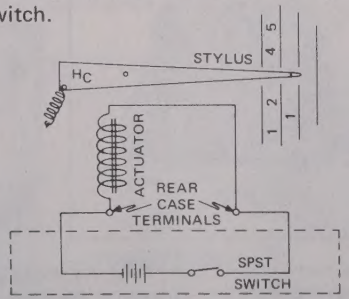
Operating Instructions

MODELS 288, 291, 2146, 300 SERIES

1. Install recorder and wire as detailed on page 3.
2. Load chart paper as shown on pages 4 & 5.
3. Apply power to motor and zero trace if needed.
4. Feed in signal to be recorded.
5. Recorder can operate unattended until chart paper supply is depleted.

(Event Marker), Model 2146

1. Wire actuator in series with contact switch and DC power source (Check voltage rating of actuator). See schematic.
2. Chart paper speed depends on gear train and motor combination selected for analog channel.
3. Recorder will print pulse for every change in state of contact switch.



Wiring to actuator of model 2146. Actuator responds to state of SPST switch.

Calibration: (All Models Except 2194)

No calibration except for periodic adjustment of the mechanical zero is needed on Rustrak DC recorders.

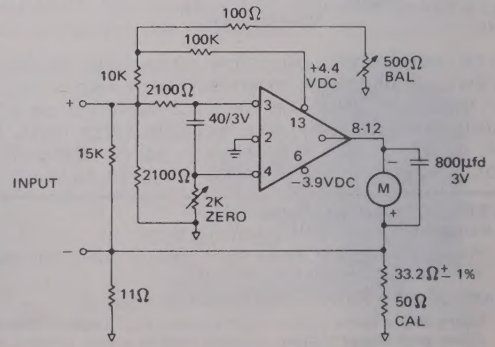
Mechanical Zero:

If trace on chart paper is above or below zero with galvanometer terminals shorted and motor running, snap out front nameplate (using fine screwdriver in slot at left) and vary zero adjust screw.

The stylus also may be adjusted mechanically at any point upscale if the recorder is used over a narrow span of the calibrated scale. Calibrate against a standard meter across the galvo terminals and a source.

See page 7 for special instructions on Model 2194.

MODEL 2194:



Model 2194 Special Instructions

The full-scale sensitivity of 1 microampere (range 0-10 mV) is achieved with a medium gain amplifier driving a 100 mV meter. Input impedance is 10,000 ohms and the recorder is intended for a maximum source impedance of 100 ohms. Error due to amplifier loading with a 100 ohm source is less than 1% but rises to about 10% with a 1K ohm source. Temperature drift is also proportionately higher.

Electrical Zero:

1. With power off, adjust mechanical zero (behind front nameplate) until stylus (at chopper bar level) is at zero on chart paper.
2. Allow ½ hour warmup with power on.
3. Short input terminals and adjust ZERO (on case rear) for zero on chart paper.
4. Remove short and adjust BALance (on case rear) for zero trace. Short terminals again. Reading should not change from open to shorted condition.
5. If any change occurs, repeat steps 3 and 4.

Calibration:

1. Zero the recorder as shown in Electrical Zero instructions.
2. Apply 10 mV signal to binding posts from generator whose output resistance is less than 100 ohms.
3. Adjust CAL control (case rear) for full-scale printout.

Increasing Current Range:

To increase range (reduce current sensitivity), a shunt at the input terminals equal to 10,000/n-1 may be used. For example, a full-scale sensitivity of 100 uA is achieved with a 101 ohm resistor while a 0.01 ohm resistor results in 1 Amp full-scale readings.

Expanding Voltage Range:

The 2194 can be made into a solid-state voltmeter with 100,000 ohms/volt sensitivity by using a series multiplier whose value in ohms equals 100,000 Vfs - 1000 (where Vfs equals volts full-scale) providing a 1K ohm resistor shunts the input of the recorder. Representative values are 1K ohm for a 10 mV range, 99K ohms for 1 volt full-scale and 1 Megohm for a 10 V. scale. The 1K resistor should be wired to the recorder directly at the binding posts before connecting the multiplier.

Caution:

Voltages in excess of 1VDC at the input may damage the amplifier.

Basic Ranges

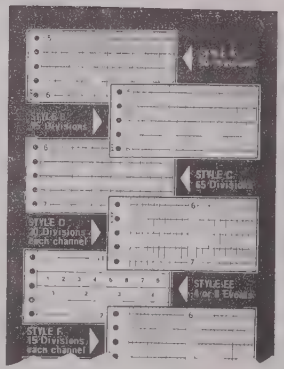
MODEL 288		
Units	Range	Galvanometer Resistance in Ohms
μA	0 10	5700
	0 50	5400
	0 100	4600 1000
	0 200	2200
	0 500	200
MA	0 1	100
MV	0 10	10
	0 25	12 5
	0 100	100

MODEL 291		
Units	Range	Galvanometer Resistance in Ohms
μA	0 50	5400
	0 100	4600 1000
MA	0 1	100
MV	0 50	100
	0 100	100

MODEL 2146	
10 μA	5700Ω
50 μA	5400Ω
100 μA	4600Ω 1000Ω
1 MA	100Ω
0 100MV	100Ω

Ranges shown are zero-left.
Also supplied in zero-center.

Chart Paper



Rustrak recorders use pressure-sensitive chart paper in 63-foot rolls for continuous one month recording at 1 inch/hour. Typical styles are shown to the left:

MODELS 288 and 2194:

Usually Style A, 50 divisions, 2-9/16" wide, useable width, 2-5/16"

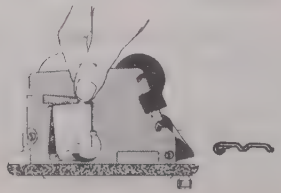
MODEL 291:

Style D, 20 div. or Style F, 15 div. per channel. Each 2-9/16" wide, useable width, 1" per channel.

MODEL 2146:

Uses Style N paper, 2-9/16" wide, useable 2" (Analog) & 1/2" (Event).

Changing Gear Trains



Open recorder. Remove gear train spring. Move gear train in direction of arrow on its case. Lift out from top. Don't force or lift from bottom.

Insert new gear train bottom in first. Slide into position against arrow directions. Replace gear train spring.

Cleaning Your Recorder

The coating used on Rustrak recorders is Nextel Brand Suede Coating by 3M. It was chosen because of its toughness and visual qualities.

It can be cleaned with a damp sponge. The usual household spray and liquid cleaners can be used on tough stains without damage to the coating.

Formulas

WRITING SPEED (strikes/sec.) = $\frac{\text{motor speed (rpm)}}{4}$

CHART SPEED (in./hr.) = $\frac{\text{motor speed (rpm)} \times \text{gear train assembly number}}{2}$

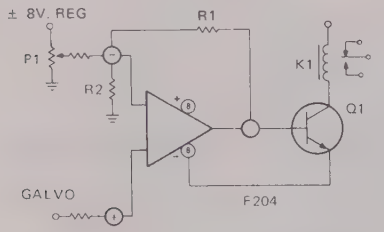
TRACE DENSITY (strikes/in.) = $\frac{1800}{\text{gear train assembly number}}$

DURATION OF ROLL (in hrs.) = $\frac{756}{\text{chart speed (in./hr.)}}$

Gear Train Ratios, Chart Speed, Writing Speed and Trace Density Table

DRIVE MOTOR (rpm)	WRITING SPEED	1/8 480:1	1/4 240:1	1/2 120:1	1 60:1	2 30:1	3 20:1	4 15:1	6 10:1	10 6:1	12 5:1	15 4:1	30 2:1	45 1.5:1	60 1:1	GEAR TRAIN NO / GEAR TRAIN RATIO
1/2	1 strike 8 seconds	1/32 inch 8 mm 144 weeks	1/16 inch 1.6 mm 72 weeks	1/8 inch 3.2 mm 9 months	1/4 inch 6.35 mm 18 weeks	1/2 inch 12.7 mm 9 weeks	3/4 inch 19 mm 6 weeks	1 inch 25.4 mm 1 month	1½ inches 38 mm 21 days	2½ inches 63.5 mm 302½ hrs	3 inches 76.2 mm 252 hrs	3.75 inches 95.3 mm 201.6 hrs	7½ inches 19 cm 100.8 hrs	11¼ inches 28.6 cm 67.2 hrs	15 inches 38 cm 50.4 hrs	English Units/Hour / Chart Metric Units/Hour / Speed Duration of Chart Paper Spool
1	1 strike 4 seconds	1/16 inch 1.6 mm 72 weeks	1/8 inch 3.2 mm 9 months	1/4 inch 6.35 mm 18 weeks	1/2 inch 12.7 mm 9 weeks	1 inch 25.4 mm 1 month	1½ inches 38 mm 21 days	2 inches 50.8 mm 378 hrs	3 inches 76.2 mm 252 hrs	5 inches 12.7 cm 151.2 hrs	6 inches 15.2 cm 126 hrs	7½ inches 19 cm 100.8 hrs	15 inches 38 cm 50.4 hrs	22½ inches 57.2 cm 33.6 hrs	2½ feet 76.2 cm 25.2 hrs	English Units/Hour / Chart Metric Units/Hour / Speed Duration of Chart Paper Spool
2	1 strike/ 2 seconds	1/8 inch 3.2 mm 9 months	1/4 inch 6.35 mm 18 weeks	1/2 inch 12.7 mm 9 weeks	1 inch 25.4 mm 1 month	2 inches 50.8 mm 378 hrs	3 inches 76.2 mm 252 hrs	4 inches 10.2 cm 189 hrs	6 inches 15.2 cm 126 hrs	10 inches 25.4 cm 75.6 hrs	1 foot 30.5 cm 63 hrs	15 inches 38 cm 50.4 hrs	2½ feet 76.2 cm 25.2 hrs	45 inches 1.14 mtrs 16.8 hrs	5 feet 1.52 mtrs 12.6 hrs	English Units/Hour / Chart Metric Units/Hour / Speed Duration of Chart Paper Spool
4	1 strike/ second	1/4 inch 6.35 mm 18 weeks	1/2 inch 12.7 mm 9 weeks	1 inch 25.4 mm 1 month	2 inches 50.8 mm 378 hrs	4 inches 10.2 cm 189 hrs	6 inches 15.2 cm 126 hrs	8 inches 20.3 cm 94½ hrs	1 foot 30.5 cm 63 hrs	20 inches 50.8 cm 37.8 hrs	2 feet 61 cm 31½ hrs	2½ feet 76.2 cm 25.2 hrs	5 feet 1.52 mtrs 12.6 hrs	7½ feet 2.29 mtrs 8.4 hrs	10 feet 3.05 mtrs 6.3 hrs	English Units/Hour / Chart Metric Units/Hour / Speed Duration of Chart Paper Spool
6	3 strikes/ 2 seconds	3/8 inch 9.53 mm 3 months	3/4 inch 19 mm 6 weeks	1½ inches 38 mm 21 days	3 inches 76.2 mm 252 hrs	6 inches 15.2 cm 126 hrs	9 inches 22.9 cm 84 hrs	1 foot 30.5 cm 63 hrs	18 inches 45.7 cm 42 hrs	2½ feet 76.2 cm 25.2 hrs	3 feet 91.4 cm 21 hrs	45 inches 1.14 mtrs 16.8 hrs	7½ feet 2.29 mtrs 8.4 hrs	11½ inches 3.43 mtrs 5.6 hrs	15 feet 4.57 mtrs 4.2 hrs	English Units/Hour / Chart Metric Units/Hour / Speed Duration of Chart Paper Spool
8	4 strikes/ second	1/2 inch 12.7 mm 6 weeks	1 inch 25.4 mm 1 month	2 inches 50.8 mm 378 hrs	4 inches 10.2 cm 189 hrs	8 inches 20.3 cm 94.5 hrs	1 foot 30.5 cm 63 hrs	16 inches 40.6 cm 47¼ hrs	2 feet 61 cm 31½ hrs	40 inches 1.02 mtrs 18.9 hrs	4 feet 1.22 mtrs 15.75 hrs	5 feet 1.52 mtrs 12.6 hrs	10 feet 3.05 mtrs 6.3 hrs	15 feet 4.57 mtrs 4.2 hrs	20 feet 6.1 mtrs 3.15 hrs	English Units/Hour / Chart Metric Units/Hour / Speed Duration of Chart Paper Spool
10	5 strikes/ 2 seconds	5/8 inch 15.9 mm 50 days	1¼ inches 31.8 mm 604 hrs	2½ inches 63.5 mm 302 hrs	5 inches 12.7 cm 151 hrs	10 inches 25.4 cm 75½ hrs	15 inches 38 cm 50½ hrs	20 inches 50.8 cm 38 hrs	2½ feet 76.2 cm 25.2 hrs	50 inches 1.27 mtrs 15 hrs	5 feet 1.52 mtrs 12.6 hrs	75 inches 1.91 mtrs 10 hrs	12.5 feet 3.8 mtrs 5 hrs.	225 inches 5.72 mtrs 3.4 hrs	25 feet 7.62 mtrs 2.5 hrs	English Units/Hour / Chart Metric Units/Hour / Speed Duration of Chart Paper Spool
12	6 strikes/ second	3/4 inch 19 mm 6 weeks	1½ inches 38 mm 21 days	3 inches 76.2 mm 252 hrs	6 inches 15.2 cm 126 hrs	1 foot 30.5 cm 63 hrs	1½ feet 45.7 cm 42 hrs	2 feet 61 cm 31½ hrs	3 feet 91.4 cm 21 hrs	5 feet 1.52 mtrs 12.6 hrs	6 feet 1.83 mtrs 10½ hrs	7½ feet 2.3 mtrs 8.4 hrs	15 feet 4.57 mtrs 4.2 hrs	22½ feet 6.86 mtrs 2.8 hrs	30 feet 9.14 mtrs 2.1 hrs	English Units/Hour / Chart Metric Units/Hour / Speed Duration of Chart Paper Spool
16	8 strikes/ second	1 inch 25.4 mm 1 month	2 inches 50.8 mm 378 hrs	4 inches 10.2 cm 189 hrs	8 inches 20.3 cm 94.5 hrs	16 inches 40.6 cm 47¼ hrs	2 feet 61 cm 31½ hrs	32 inches 81.3 cm 23.7 hrs	4 feet 1.22 mtrs 15.75 hrs	80 inches 2 mtrs 9.45 hrs	8 feet 2.44 mtrs 7.8 hrs	10 feet 3.05 mtrs 6.3 hrs	20 feet 6.1 mtrs 3.15 hrs	30 feet 9.14 mtrs 2.1 hrs	40 feet 12.2 mtrs 1.6 hrs	English Units/Hour / Chart Metric Units/Hour / Speed Duration of Chart Paper Spool
TRACE DENSITY		14400	7200	3600	1800	900	600	450	300	180	150	120	60	40	30	STRIKES PER INCH (DENSITY)

F204 Controller



Milliameters and microammeters are basically low-range volt meters which register voltage excursions at their terminals. These minute fluctuations represent a real change in the monitored circuit and can be used to control circuit quantities. That's the function of the F204 On-Off Controller Feature.

The F204 is a comparator amplifier driving a power transistor in series with a relay. SPDT contacts enable on-off control of parameters being recorded or the external wiring may be adapted to open or close any circuit to follow voltage excursions at the galvanometer terminals. By comparing voltage levels of the meter terminals with a stable reference voltage adjustable from the front panel, limits can be set for the relay switching function.

Both the reference voltage and the voltage impressed across the meter terminals are applied to the inputs of an operational amplifier.

The operational amplifier in the F204 is operated open-loop, that is, with no feedback. Its voltage gain, including the power stage driving relay K1, is about 125,000 or 0.2 millivolts at the input give 24 volts out.

Voltage across the galvo is applied to the positive input. P1 is the front panel setpoint adjustment that varies the reference voltage applied to the negative input.

When the voltage of the positive input terminal (the galvo input) is below or equal to the voltage at the negative terminal (the reference), Q1 is cut-off and K1 de-energized. If the positive terminal becomes more positive than the – terminal by more than about 0.2 millivolts (resolution), Q1 conducts and energizes K1.

Loading on the galvanometer, because the input impedance of the op amp is about 30 megohms, is limited to about 0.2 microamperes.

Relay contacts are rated 5 amps, resistive load, at 30 VDC or 115 VAC. The "normally-open" and "normally-closed" contacts can be adapted to almost any application whose functions lend themselves to on-off control.

Configurations (A or B) represent control direction. The A style closes the normally-open contact below the setpoint and opens it above.

Style B configuration closes relay contacts above the setpoint and opens them below.

Besides these simple styles, two setpoint controllers are available. Style AA, featuring two control amplifiers both actuating the relay below the setpoint, are useful for control at one point and shut-down or alarming at the other.

Style AB is useful in "go-no-go" applications, or, "low-in-high" type of information needs. Similar applications as with style AA are possible with the BB configuration but with control above the setpoint.

No controller is limited to its initial configuration since styles can be changed by the user.

The type of setpoint, whether low (A) or high (B), depends on galvanometer connections relative to the reference voltage. Since the relay energizes only when the positive terminal of the op amp is more positive than the – terminal, it is possible to change setpoint types by reversing connections to the galvo.

These connections are jumpers on the controller circuit board mounted on the case rear. The jumpers are located at the bottom of the PC board in this sequence:

Criss-cross or "X" jumpers denote an "A" type configuration while parallel (II) jumpers result in a "B" configuration.

To change setpoint types, remove four screws holding case rear to recorder housing. Then unscrew PC board from the rear panel. When soldering, be careful not to destroy the printed circuit board.

ADJUSTING PANEL KNOBS:

1. Apply signal to galvanometer for center scale reading.
2. Adjust controller setpoint knob until relay (de) actuates. Swing knob back and forth. Only slight movement of knob should be possible between on and off.
3. With galvo at center scale and reference pot at the control point the knob should be at the center mark on its dial. If not, loosen set screw and move pointer to center mark.
4. Check knob pointer against scale at 0, 20, 40, 60 and 100 percent points. A deviation of one division at any point is acceptable.

Features and Accessories

F109A, SELECTIVE COMMAND PRINT:

Recorders with this feature have a solenoid-actuated striker rather than one which operates from the motor cam. (There is no cam). No recording occurs until the solenoid is energized and the striker presses the stylus against the paper until released by the solenoid. Average duty cycle must not exceed 25 percent.

Connections are made through two binding posts on the case rear. They are labeled for correct voltages.

F109B, AUTOMATIC COMMAND PRINT:

This feature retains the cam-operated striker but the motor cam doesn't engage until the solenoid is energized. Recorder operates normally as long as solenoid is actuated. Duty cycle can be up to 100%.

Connections to solenoid are made through binding posts labeled for correct voltages.

F1A, QUIET FEATURE:

The Quiet Feature reduces impact noise of the striker by changing the writing method to a pressing action. This is a mechanical feature only. The F1A is functional with all motors and gear trains available.

But since the cam arrangement differs from that of a regular recorder, the writing speed is based on strikes-per-15 seconds rather than strikes-per-second. Writing speed is about half as fast as that of a recorder without the F1A.

Strikes/15 sec.	1	2	4	8	12	16	20	24	32
Motor (rpm)	½	1	2	4	6	8	10	12	16

F137, TWO–POINT FEATURE:

Recorders with this feature print two traces on the chart with only one galvanometer. Inputs are switched through a motor cam to produce two independent traces identified by a regular break in one recording. A Model 288/F137 can monitor two signals while a 291-F137 is a four-channel recorder.

WIRING; MODEL 288:

The second channel input is wired to pins 5 & 6 of the chassis plug. Other models use binding posts on the case rear. Check the label inside your recorder for correct wiring.

SPEED LIMITATIONS:

Because of the extra cam, limitations in chart and writing speed are inherent with the F137. Maximum motor speed is 1 rpm and only gear boxes #1/8 to #12 can be used in the recorder.

111 & 881:

Switchable shunts and multipliers as also hi-current shunts are available for Models 288 and 291. Separate instructions accompany these accessories.

F217 AMPLIFIER FEATURE:

Input terminals for recorders with the F217 feature are binding posts on the case rear. The slide switch controls both amplifier and motor power.

Mechanical Zero:

With power off and striker bar allowing free swing of meter stylus (shut off recorder when striker bar does not impinge on stylus), adjust mechanical zero located behind front nameplate.

Electrical Zero & Calibration:

With power on and input binding posts shorted together, adjust Zero control accessible through case rear for zero trace on chart.

Remove short. Feed in an accurate signal equal to full-scale marking and adjust "Calibrate" control for full-scale trace. This control allows a variation of ±10% from full-scale design point.

Troubleshooting and Repair

Your Rustrak recorder is engineered for long and dependable service. It needs no maintenance schedule or lubrication.

But as a precision instrument, it should be given the best of care.

Many problems during use are due to improper chart loading, incorrect wiring or mishandling.

Typical problems are shown in the accompanying chart.

SYMPTOM	POSSIBLE CAUSE	SERVICE HINT
Meter records above or below zero with no signal applied.	Meter zero out of adjustment	Remove front nameplate. Adjust mechanical zero.
Meter can't be zeroed	Stylus bent; cross arm bent.	Return instrument to factory.
Meter reads zero with-signal applied.	Meter open. Connections to meter open; multiplier resistor open.	Check meter (Do not use VOM) Check wiring to galvo. Check plug and terminal wiring Read out multiplier resistor with VOM.
Meter hangs above zero.	Dust in meter pivots.	Return recorder to factory.
Offset stylus visibly bent.	Meter has been overloaded.	Return recorder to factory.
Recorder has continuous trace.	Stylus bent; rubs on chart paper.	Return to factory.
Meter reads consistently below zero.	Polarity to meter reversed.	Check wiring to mating socket. Check polarity of signal being recorded.
Reroll mode: Paper crinkles at view window.	Take-up spool not seated to engage drive gear.	Unlatch retaining clip: reseat take-up spool in further notch.
Reroll. Paper doesn't drive through recorder.	Perforations not engaged in drive drum. Gear train doesn't engage drive drum.	Reload following loading instructions. Bend tabs on gear train slightly for end play; Bend gear train spring for more tension.
Tear-off: Paper doesn't drive through tear-off slot.	Drive belts not seated on take-up roller. Also riding in large center groove of drive belt roller.	Seat drive belts as shown in loading instructions.
Paper tears on drive drum	Roll of chart paper is spiraled.	Reload taking care chart paper is perfectly aligned.
Chart advance thumbwheel is locked.	Tab that disengages gear train is bent.	Remove gear train and straighten tab.

When testing, refer to Exploded View.

Other than service hints outlined on this page, we recommend factory service by technicians trained and equipped to troubleshoot and repair your recorder. Should you wish factory repair assistance, pack your recorder in a carton equal to the original packaging. Insure to full value and ship prepaid. Include a letter giving full details with your packing list.

Send to:

Customer Service Department
Rustrak Instrument Div., Gulton Industries, Inc.
Municipal Airport, Manchester, N. H. 03103

rustrak THE MINIATURE RECORDER PEOPLE

FIRST CLASS
Permit No.
6408
Manchester,
N.H.

BUSINESS REPLY MAIL

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Postage will be paid by —

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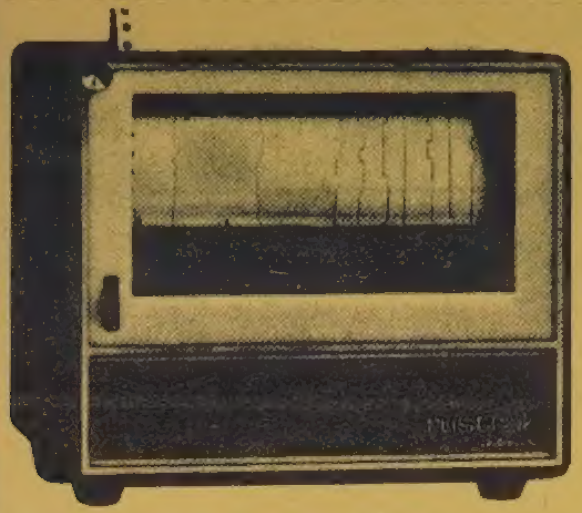
BESIDES THE RECORDERS LISTED IN THIS MANUAL, RUSTRAK MAKES EVENT RECORDERS, TEMPERATURE RECORDERS, PRESSURE RECORDERS, AC RECORDERS, AND COMBINATIONS OF RECORDERS FOR ALMOST EVERY POSSIBLE APPLICATION. SEND IN THE ATTACHED POSTCARD TO RESERVE YOUR COPY OF OUR LATEST CATALOG.



New Dual Width "300" Series

Rustrak's new dual width Series 300 Miniature Recorders enable you to design your own tandem unit using any two functions from standard single unit Series 200.

- Inkless, dry writing, rectilinear recording on pressure-sensitive paper.
- Wide range of sensitivities, writing and chart speeds. AC or DC drives available.
- Tearoff and reroll operation.
- Accuracy ±2% of full scale.

Get the facts at your fingertips on Current, Voltage, Temperature, Pressure, Events, Dissolved Oxygen, and other functions in the laboratory and in the plant.

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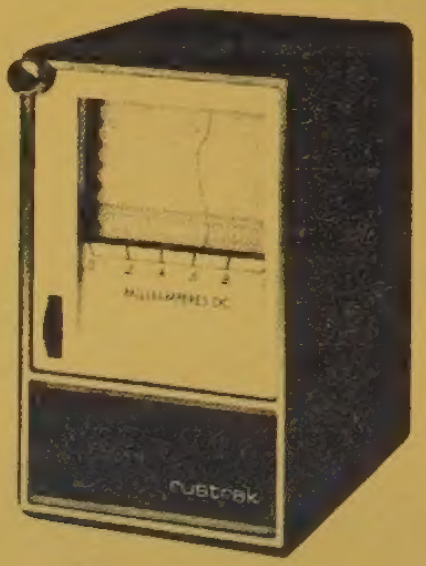
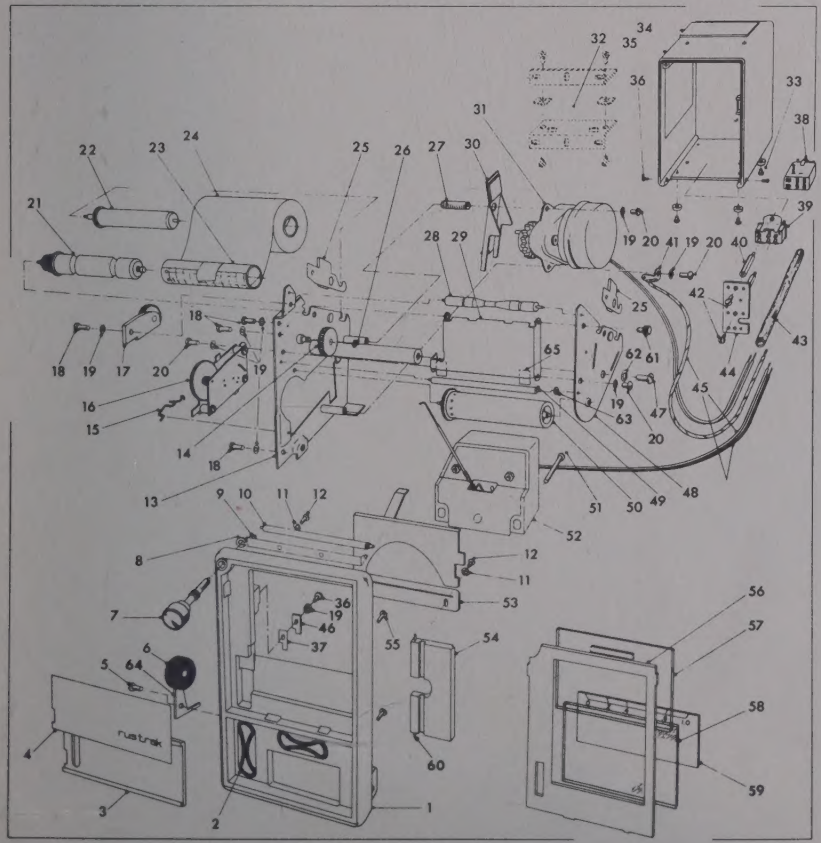


Standard "200" Series

Exploded View of a Typical Model 288 Recorder

EXTRA COPIES OF EXPLODED VIEW ARE GRATIS FROM RUSTRAK BY SPECIFYING # 27007.



ITEM	PART NO.	DESCRIPTION
	C 4211 GI	FRONT PANEL ASSEMBLY
2	A 4553 PI	BELT, DRIVE
3	B 4131 PI	BEZEL, LOWER
4	A 4228 PI	NAMEPLATE
5	A 4218 PI	SCREW, SPECIAL
6	A 3280	THUMBWHEEL, CHART ADVANCE
7	A 4422 PI	THUMBSCREW
8	A 4557 PI	RING, RETAINING
9	B 4119 PI	BRACKET, FRICTION ROLLER
10	A SA 1339 GI	FRICTION ROLLER ASSEMBLY
11	L1 2	LOCK WASHER, INTERNAL TOOTH #2
12	2 56x1/8LG	MACH. SCREW, PAN HD. SST
13	B 4584 GI	LEFT HAND PLATE ASSEMBLY
14	A 2232	GEAR, IDLER
15	A 2354	SPRING, GEAR TRAIN
(1)	16	AS REQ'D GEAR TRAIN ASSEMBLY
17	A 4478 GI	ARM AND GEAR ASSEMBLY
18	4 40x5/16LG	MACH. SCREW, PAN HD. SST
19	L1 4	LOCK WASHER, INTERNAL TOOTH #4
20	4 40x1/4LG	MACH. SCREW, PAN HD. SST
21	B 4488 GI	TAKE UP ROLLER ASSEMBLY
22	B 2316 PI	ROLLER, SUPPLY
23	A 2254 PI	SLEEVE, CARDBOARD
(2)	24	AS REQ'D PAPER, STRIP CHART
25	B 2348 P2	CLIP, RETAINING
26	5100 18 C MF	RING, RETAINING
27	A 4185 PI	SPRING, BRAKE
28	B 4220 PI	ROLLER
29	B 2474	PLATE, FRONT SUPPORT
30	A 4548 GI	BRAKE ASSEMBLY
(3)	31	AS REQ'D MOTOR ASS'Y & CAM (115V, 60HZ, 2RPM)
32	B 4492 GI	HARDWARE KIT, PANEL MTG.
33	B 4549 GI	RUBBER FEET, (4) WITH SCREWS
34	B 4313 PI	CARDHOLDER
35	D 2244 2 G	CASE, BASIC
36	4 40x3/16LG	MACH. SCREW, FIL. HD. SST
37	A 4252 PI	RATCHET, CHART ADVANCE
38	A 4558 PI	SOCKET, CABLE
39	A 4559 PI	PLUG, CHASSIS
40	A 2229 PI	SPACER
41	A 4303 PI	LUG, DUAL
42	6 32x1/4LG	MACH. SCREW, PAN HD. SST
43	A 4546 PI	TUBING, NO. 3 .234 I.D.
44	B 2456 PI	BOARD
45	A 4555	WIRE
46	A 4251 PI	STIFFENER, RATCHET
47	B 32x5/16LG	MACH. SCREW, PAN HD. SST
48	C 4302 PI	PLATE, RIGHT HAND
49	A 2203 PI	ROLLER, CENTER
50	B 4550 GI	TIME DRUM ASSEMBLY
51	6 32x1 5/16LG	MACH. SCREW, PAN HD. SST
(4)	52	AS REQ'D METER ASS'Y (1 MA.)
53	B 4497 GI	STRIKER AND ARM ASSEMBLY
54	C 4214 P2	LATCH, CHASSIS
55	4 40x3/16LG	MACH. SCREW, PAN HD. SST
56	B 4117 PI	BEZEL, FRONT PANEL
57	B 4178 PI	WINDOW, ACCESS
58	B 4179 PI	WINDOW, BOTTOM
(5)	59	AS REQ'D SCALE (STD.) ONLY
60	A 4551 PI	PIN, LATCH
*	61	A 4552 P2 CAP SCREW, HEX. SOC. HD.
62	L1 8	LOCK WHASER, INTERNAL TOOTH #8
63	A 4157 PI	WASHER, NYLON
64	A 4219 GI	HINGE BRACKET ASSEMBLY
65	A 4089	SPRING, LEAF

(1) SPECIFY GEAR TRAIN NO. REQUIRED INTERCHANGEABLE GEAR TRAIN AFFECTS SPEED. SEE CATALOG.

(2) SPECIFY CHART PAPER STYLE.

(3) WHEN ORDERING, INCLUDE MOTOR SPEED, VOLTAGE AND FREQUENCY. SEE CATALOG.

(4) SPECIFY METER PART NO. WRITE FOR PRICES.

(5) SPECIFY SENSITIVITY, RANGE, PARAMETER AND SPECIAL MARKINGS, IF ANY.

"200" Series Template